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Ocean University of China

Ocean Monitoring and Inspection Center

Monitoring (Inspection) Report

OUC (Testing) No. HDJC2012-005

Client: Qingdao Headway Technology Co., Ltd.

Project Name: Scaling Test of OceanGuard™ Ballast Water
Management System

Inspection Dept.: Marine Chemistry Analysis and Detection Laboratory

Approved by: _____

Date of issue: _____

13/11/2012

Inspected by.: Ocean Monitoring and Inspection Center,

Ocean University of China



STATEMENT

1. The report is invalid without the official seal of Ocean Monitoring and Inspection Center, Ocean University of China (hereinafter referred to as the Center).
2. Copy of the report is invalid without the original seal of the Center.
3. The report is invalid without signature of test operator, verifier, and authorizer.
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To improve our testing capability and service quality continuously and to better serve clients and the community, comments from all sectors of the community to the Center are warmly welcome.

Ocean Monitoring and Inspection Center

Ocean University of China

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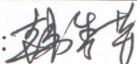
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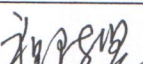
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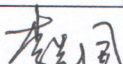
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Name of project	Scaling Testing of OceanGuard™ Ballast Water Management System			
Client	Name: Qingdao Headway Technology Co., Ltd. Add: F4, #5Building, Huite Industrial City, Zhuzhou Road, Qingdao, China Tel: (+86) -532-88702808			
Project Description	Entrusted by Qingdao Headway Technology Co., Ltd., the project comprises tests on physical, chemical and biological parameters and gas concentration of ballast water treated by OceanGuard™ Ballast Water Management System, in the test facility, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd. There are three types of OceanGuard™ Ballast Water Management Systems tested in this project (HMT-50, HMT-1200, HMT-3000). Ocean Monitoring and Inspection Center, Ocean University of China acts as the implementation party of the project, and accredited staffs from the Center were appointed to the test sites to supervise the operation of the whole process and to carry out sampling and on-site inspection as required. Off-site testing samples were delivered to specified laboratories of the Center and tested by accredited staffs within a specified period. Three test cycles were carried out, during the following period. First cycle, Sep. 25th to 30th, 2012. Second cycle, Oct., 10th to Oct., 15th, 2012. Third cycle, Oct. 16th to 21st, 2012. The operation, sampling, and inspection procedures were under supervision of CCS and DNV.			
Test Equipment	NO.	Name	Model	Main Parameter
	1	Ballast pump	Outsourcing	Rated Capacity: 100 m³/h and 2200 m³/h
	2	Filter	HMT-50F	Rated Capacity: 50 m³/h
			HMT-1200F	Rated Capacity: 1200 m³/h
			HMT-3000F	Rated Capacity: 3000 m³/h
	3	EUT Unit	HMT-50E	Rated Capacity: 50 m³/h
			HMT-1200E	Rated Capacity: 1200 m³/h
			HMT-3000E	Rated Capacity: 3000 m³/h
	4	Flow Meter	HMT-125FM,	DN125
			HMT-600FM	DN600
	5	Neutralization Unit	HMT-600N	Volume: 600L
	6	Monitoring Unit	HMT-TRO	—
	7	Power Distribution Unit	HMT-PDU	—
	8	Control Unit	HMT-CL	—
Test Process and Equipment	See report page 22 -26			

Test Operator: 

Verifier: 

Authorizer: 

Date: 7/11/2012

Date: 7/11/2012

Date: 8/11/2012

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Sampling and Storage	No.	Item	Sample Container	Collected Volume	Preservation	Expected Storage Time
	1	Temperature	Plastic Bottle	1 L	Test on site	—
	2	Salinity			Test on site	—
	3	TRO	Pretreated Plastic Bottle	1 L	Test on site	—
	4	DOC	Pretreated Plastic Bottle	1 L	0-4 °C	≤7 days
	5	POC	Pretreated Plastic Bottle	1 L	0-4 °C	≤7 days
	6	TSS	Pretreated Plastic Bottle	1 L	0-4 °C	≤24 hrs
	7	Organisms ≥50 μm	Sterile Plastic Bottle	1 m ³	Test on site	≤6 hrs
	8	Organisms ≥10-50 μm	Sterile Plastic Bottle	1 L	4 °C	≤24 hrs
	9	Heterotrophic Bacteria	Sterile Plastic Bottle	1 L	4 °C	≤24 hrs
	10	<i>E. coli</i>				
	11	<i>Vibrio Cholera</i>				
	12	Enterococcus Group Bacteria				
	13	H ₂	—	—	Test on site	—
Remark						

Test Operator: 韩东英

Verifier: 刘明

Authorizer: 李光同

Date: 7/11/2012

Date: 7/11/2012

Date: 8/11/2012

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Testing Method and Major Instrument	No.	Item	Method	Major Instrument
	1	Temperature	Sensor Detection	VICTOR TP01
	2	Salinity	Sensor Detection	HOTEC SC-106
	3	TRO	DPD	HACH DR/2800
	4	DOC	Catalytic Combustion	SHIMADZU TOC-Vcpn
	5	POC	Catalytic Combustion	SHIMADZU TOC-Vcpn
	6	TSS	Weighting	DDG-9203 Electric Blast Drying Oven METTLER TOLEDO EL104 Balance
	7	Organisms $\geq 50 \mu\text{m}$	Microscope Determination	OPTEC SMJ-T2 Stereo Microscope
	8	Organisms $\geq 10-50 \mu\text{m}$	CFDA	Leica OMLA Fluorescence Microscope YUE FENG SPX-150 Low-temperature Incubator
	9	Heterotrophic Bacteria	Plate Counting	YUE FENG SPX-150 Low-temperature Incubator
	10	E. coli	Counting after membrane filtration	YUE FENG SPX-150 Low-temperature Incubator
	11	Enterococcus group bacteria	Counting after membrane filtration	YUE FENG SPX-150 Low-temperature Incubator
	12	Vibrio cholera	Counting after membrane filtration	YUE FENG SPX-150 Low-temperature Incubator
	13	H ₂	Sensor Detection	HAN WEI BX618 Gas Detector
Testing Results	See report page 4 -21			
Laboratory Environment	Temperature	19.0 °C	Humidity	70 %
Remark				

Test Operator:

Date: 7/11/2012

Verifier:

Date: 7/11/2012

Authorizer:

Date: 8/11/2012

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1 Testing results of Cycle 1

1.1 Operation Condition

Name of the system: OceanGuard™ Ballast Water Management System

Manufacturer: Qingdao Headway Technology Co., Ltd.

Location: No. 8 Wharf, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd.

Cycle NO.: Cycle 1

Date: 09/25/2012—09/30/2012


Weather (Ballasting) : Sunny

Longitude: 35°59.18'E

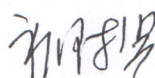
Latitude: 120°16.25'N

Water Depth: 9.6 m

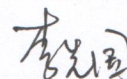
Test Operator:



Verifier:



Authorizer:



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1.2 Operation Data

Table 1.2.1 Operation time and flow

Date	Process Description	Start Time	Stop Time	Average Flow Rate (m ³ /h)
2012/09/25	Treated Water (HMT-50)	11:43	12:13	83.35
2012/09/25	Treated Water (HMT-1200)	10:44	11:09	1302
2012/09/25	Treated Water (HMT-1200)	10:03	10:23	3068
2012/09/25	Control Water	12:38	13:26	3053

Test Operator:

韩春荣

Verifier:

初明华

Authorizer:

李国

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1.3 Test result of water and gas

Table 1.3.1 Test result of influent water

Item	Influent Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	23.7±0.3	23.9±0.8	23.7±0.2
Salinity (PSU)	31.0±0.2	31.0±0.3	30.8±0.2
TRO (mg/L)	0.01±0.01	0.01±0.01	0.00±0.00
POC (mg/L)	0.44±0.02	0.46±0.05	0.47±0.08
DOC (mg/L)	1.94±0.23	2.07±0.11	2.36±0.25
TSS (mg/l)	7.13±0.85	7.75±1.50	7.91±0.79
H ₂ (%LEL)	0.0	0.0	0.0

Table 1.3.2 Test result of treated water

Item	Treated Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	23.7±0.2	23.5±0.2	23.7±0.1
Salinity (PSU)	31.2±0.1	31.3±0.1	31.0±0.3
TRO (mg/L)	2.04±0.02	1.97±0.02	1.98±0.04
POC (mg/L)	0.43±0.06	0.48±0.08	0.38±0.05
DOC (mg/L)	1.98±0.08	2.08±0.20	2.70±0.46
TSS (mg/l)	7.14±0.24	7.75±1.50	7.38±0.95
H ₂ (%LEL)	0.0	0.0	0.0

Test Operator:

韩东荣

Verifier:

刘学华

Authorizer:

李国

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Table 1.3.3 Test result of discharged water

Item	Discharged Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	23.8 ± 0.1	23.5 ± 0.2	23.7 ± 0.2
Salinity (PSU)	31.1 ± 0.3	31.2 ± 0.1	31.1 ± 0.2
TRO (mg/L)	0.01 ± 0.00	0.01 ± 0.01	0.01 ± 0.01

Table 1.3.4 Test result of control water

Item	Control Water
Temperature (°C)	24.0 ± 1.2
Salinity (PSU)	31.4 ± 0.6
TRO (mg/L)	0.01 ± 0.01
POC (mg/L)	0.36 ± 0.03
DOC (mg/L)	2.02 ± 0.09
TSS (mg/L)	7.65 ± 1.26
Organisms $\geq 50 \mu\text{m}$ (/m ³)	502.84 ± 17.02
Organisms $\geq 10-50 \mu\text{m}$ (/mL)	$(1.42 \pm 0.50) \times 10^2$
Heterotrophic bacteria (/100 mL)	$(3.33 \pm 3.46) \times 10^7$
E. coli (/100 mL)	$(1.09 \pm 0.28) \times 10^2$
Enterococcus group bacteria (/100 mL)	$(5.74 \pm 1.72) \times 10^2$
Vibrio cholera (/100 mL)	$(2.33 \pm 0.63) \times 10^2$
H ₂ (%LEL)	0.0

Test Operator: 韩晓荣 赵明国 Verifier: 初传男 Authorizer: 李光同

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Table 1.3.5 Test result of storage tank (T1)

Item	T1 (Water Treated by HMT-50)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	23.4	22.8	18.1	18.6	18.4
Salinity (PSU)	30.8	30.8	30.8	30.8	30.8
TRO (mg/L)	0.12±0.01	0.03±0.02	0.01±0.01	0.01±0.01	0.01±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Table 1.3.6 Test result of storage tank (T2)

Item	T2 (Water Treated by HMT-1200)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	23.3	22.6	17.8	18.3	18.2
Salinity (PSU)	30.7	30.8	30.8	30.7	30.8
TRO (mg/L)	0.09±0.01	0.04±0.02	0.01±0.01	0.00±0.01	0.01±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Table 1.3.7 Test result of storage tank (T3)

Item	T3 (Water Treated by HMT-3000)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	23.2	22.7	17.9	18.5	17.9
Salinity (PSU)	30.8	30.9	30.8	30.8	30.8
TRO (mg/L)	0.11±0.01	0.04±0.01	0.01±0.01	0.00±0.01	0.00±0.00
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Test Operator:

韩东景

Verifier:

初付光

Authorizer:

李先国

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Table 1.3.8 Test result of Storage Tank (T4)

Item	T4 (Control Water)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	23.5	22.9	18.4	19.1	18.6
Salinity (PSU)	31.0	30.8	30.8	30.8	30.8
TRO (mg/L)	0.03±0.01	0.00±0.01	0.01±0.01	0.01±0.01	0.00±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Test Operator: 韩秀荣

Verifier: 刘明

Authorizer: 李国

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2 Testing results of Cycle 2

2.1 Operation Condition

Name of the system: OceanGuard™ Ballast Water Management System

Manufacturer: Qingdao Headway Technology Co., Ltd.

Location: No. 8 Wharf, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd.

Cycle NO.: Cycle 2

Date: 10/10/2012—10/15/2012

Weather (Ballasting) : Sunny

Longitude: 35°59.18'E

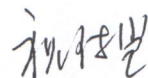
Latitude: 120°16.25'N

Water Depth: 9.9 m

Test Operator:



Verifier:



Authorizer:



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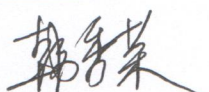
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2.2 Operation Data

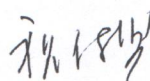
Table2.2.1 Operation time and flow

Date	Process Description	Start Time	Stop Time	Average Flow Rate (m ³ /h)
2012/10/10	Treated Water (HMT-50)	11:27	12:02	68.41
2012/10/10	Treated Water (HMT-1200)	10:30	11:00	1267
2012/10/10	Treated Water (HMT-1200)	9:40	10:10	3148
2012/10/10	Control Water	12:15	13:05	3068

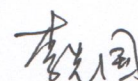
Test Operator:



Verifier:



Authorizer:



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2.3 Test result of water and gas

Table 2.3.1 Test result of influent water

Item	Influent Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	22.6 ± 0.1	21.9 ± 0.5	21.3 ± 0.5
Salinity (PSU)	31.4 ± 0.2	31.2 ± 0.3	31.1 ± 0.6
TRO (mg/L)	0.02 ± 0.01	0.02 ± 0.01	0.02 ± 0.01
POC (mg/L)	0.67 ± 0.08	0.76 ± 0.11	0.57 ± 0.08
DOC (mg/L)	2.27 ± 0.19	1.75 ± 0.02	1.79 ± 0.04
TSS (mg/l)	3.52 ± 0.89	5.08 ± 0.32	5.06 ± 1.05
H ₂ (%LEL)	0.0	0.0	0.0

Table 2.3.2 Test result of treated water

Item	Treated Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	22.6 ± 0.2	22.0 ± 0.1	21.7 ± 0.2
Salinity (PSU)	31.5 ± 0.3	31.3 ± 0.2	31.3 ± 0.3
TRO (mg/L)	2.01 ± 0.05	1.90 ± 0.02	1.96 ± 0.03
POC (mg/L)	0.60 ± 0.03	0.74 ± 0.21	0.65 ± 0.02
DOC (mg/L)	1.93 ± 0.02	1.76 ± 0.05	1.76 ± 0.02
TSS (mg/l)	4.61 ± 1.94	5.01 ± 0.67	3.60 ± 0.44
H ₂ (%LEL)	0.0	0.0	0.0

Test Operator:

韩学荣

Verifier:

刘世华

Authorizer:

李元同

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Table 2.3.3 Test result of discharged water

Item	Discharged Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	23.3 ± 0.7	22.1 ± 0.32	22.0 ± 0.5
Salinity (PSU)	31.6 ± 0.2	31.4 ± 0.1	31.6 ± 0.0
TRO (mg/L)	0.03 ± 0.01	0.02 ± 0.01	0.03 ± 0.01

Table 2.3.4 Test result of control water

Item	Control Water
Temperature (°C)	24.7 ± 0.4
Salinity (PSU)	31.4 ± 0.2
TRO (mg/L)	0.03 ± 0.01
POC (mg/L)	0.64 ± 0.03
DOC (mg/L)	1.83 ± 0.04
TSS (mg/L)	5.30 ± 0.50
Organisms ≥ 50 μm (/m ³)	674.54 ± 33.53
Organisms ≥ 10-50 μm (/mL)	(2.61 ± 0.78) × 10 ²
Heterotrophic bacteria (/100 mL)	(7.76 ± 8.79) × 10 ⁷
<i>E. coli</i> (/100 mL)	(2.83 ± 0.14) × 10 ²
Enterococcus group bacteria (/100 mL)	(1.25 ± 0.02) × 10 ²
<i>Vibrio cholera</i> (/100 mL)	(2.32 ± 0.63) × 10 ²
H ₂ (%LEL)	0.0

Test Operator:

韩冬来

Verifier:

孙永刚

Authorizer:

李国

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Table 2.3.5 Test result from storage tank (T1)

Item	T1 (Water Treated by HMT-50)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	21.5	22.1	21.8	21.6	22.2
Salinity (PSU)	31.4	31.4	31.4	31.4	31.4
TRO (mg/L)	0.14±0.04	0.04±0.01	0.01±0.01	0.01±0.01	0.01±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Table 2.3.6 Test result from storage tank (T2)

Item	T2 (Water Treated by HMT-1200)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	22.2	21.3	21.8	21.6	21.4
Salinity (PSU)	31.1	30.9	30.8	30.7	30.7
TRO (mg/L)	0.12±0.01	0.05±0.01	0.01±0.01	0.01±0.01	0.01±0.00
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Table 2.3.7 Test result from storage tank (T3)

Item	T3 (Water Treated by HMT-3000)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	21.4	20.8	21.2	21.3	21.1
Salinity (PSU)	31.2	31.0	31.1	31.1	31.0
TRO (mg/L)	0.11±0.02	0.03±0.01	0.00±0.01	0.00±0.01	0.00±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Test Operator: 韩某某

Verifier: 刘某某

Authorizer: 李某某

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Ocean Monitoring and Inspection Center, Ocean University of China
(Attachment)

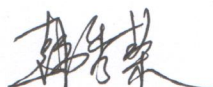
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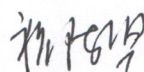
Table 2.3.8 Test result from storage tank (T4)

Item	T4 (Control Water)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	21.7	22.3	21.8	21.6	21.4
Salinity (PSU)	30.8	31.1	30.8	30.7	30.7
TRO (mg/L)	0.03±0.00	0.02±0.01	0.01±0.01	0.01±0.01	0.00±0.00
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

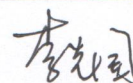
Test Operator:



Verifier:



Authorizer:



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3 Testing results of Cycle 3

3.1 Operation Condition

Name of the system: OceanGuard™ Ballast Water Management System

Manufacturer: Qingdao Headway Technology Co., Ltd.

Location: No. 8 Wharf, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd.

Cycle NO.: Cycle 3

Date: 10/16/2012—10/21/2012

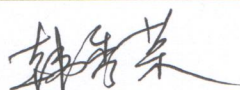
Weather (Ballasting) : Cloudy

Longitude: 35°59.18'E

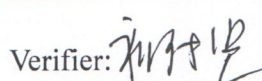
Latitude: 120°16.25'N

Water Depth: 9.2 m

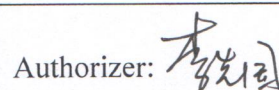
Test Operator:



Verifier:



Authorizer:



Monitoring (Inspection) Report

Ocean Monitoring and Inspection Center, Ocean University of China
(Attachment)

No. HDJC2012-005

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3.2 Operation Data

Table 3.2.1 Operation time and flow

Date	Process Description	Start Time	Stop Time	Average Flow Rate (m ³ /h)
2012/10/16	Treated Water (HMT-50)	13:25	13:55	57.97
2012/10/16	Treated Water (HMT-1200)	10:35	11:05	1283
2012/10/16	Treated Water (HMT-1200)	9:30	10:05	2998
2012/10/16	Control Water	14:10	15:05	3066

Test Operator:

韩生荣

Verifier:

孙永刚

Authorizer:

李元同

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3.3 Test result of water and gas

Table 3.3.1 Test result of influent water

Item	Influent Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	21.1±0.2	21.2±0.2	21.0±0.1
Salinity (PSU)	31.5±0.2	31.2±0.1	31.5±0.1
TRO (mg/L)	0.01±0.01	0.02±0.02	0.01±0.01
POC (mg/L)	0.39±0.06	0.37±0.05	0.45±0.11
DOC (mg/L)	1.69±0.09	1.52±0.06	1.66±0.05
TSS (mg/l)	7.72±1.17	9.91±1.45	10.28±0.88
H ₂ (%LEL)	0.0	0.0	0.0

Table 3.3.2 Test result of treated water

Item	Treated Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	21.1±0.2	21.2±0.2	21.0±0.2
Salinity (PSU)	31.6±0.1	31.6±0.1	31.5±0.2
TRO (mg/L)	2.06±0.04	1.93±0.01	2.02±0.06
POC (mg/L)	0.41±0.03	0.38±0.07	0.46±0.11
DOC (mg/L)	1.71±0.10	1.52±0.03	1.52±0.08
TSS (mg/l)	6.95±1.70	10.08±1.14	7.93±0.45
H ₂ (%LEL)	0.0	0.0	0.0

Test Operator:

韩东荣

Verifier:

祁芳芳

Authorizer:

李光同

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Table 3.3.3 Test result of discharged water

Item	Discharged Water		
	HMT-50	HMT-1200	HMT-3000
Temperature (°C)	21.0±0.2	21.2±0.3	21.1±0.2
Salinity (PSU)	31.7±0.6	31.6±0.1	31.6±0.1
TRO (mg/L)	0.01±0.01	0.01±0.01	0.05±0.02

Table 3.3.4 Test result of control water

Item	Control Water
Temperature (°C)	21.2±0.1
Salinity (PSU)	31.6±0.1
TRO (mg/L)	0.01±0.02
POC (mg/L)	0.37±0.02
DOC (mg/L)	1.70±0.06
TSS (mg/L)	6.38±0.30
Organisms≥50 μm (/m ³)	587.65±43.24
Organisms ≥10-50 μm (/mL)	(2.03±0.44)×10 ²
Heterotrophic bacteria (/100 mL)	(3.22±4.34)×10 ⁸
<i>E. coli</i> (/100 mL)	(2.64±1.51)×10 ²
Enterococcus group bacteria (/100 mL)	(5.21±1.51)×10 ²
<i>Vibrio cholera</i> (/100 mL)	(7.89±1.26)×10 ²
H ₂ (%LEL)	0.0

Test Operator:

韩学荣

Verifier:

孙永刚

Authorizer:

李光国

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Ocean Monitoring and Inspection Center, Ocean University of China
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No. HDJC2012-005

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Table 3.3.5 Test result from storage tank (T1)

Item	T1 (Water treated by HMT-50)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	18.7	18.2	18.4	18.6	18.6
Salinity (PSU)	31.2	31.3	31.1	31.4	30.3
TRO (mg/L)	0.12±0.02	0.03±0.01	0.01±0.01	0.01±0.01	0.01±0.00
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Table 3.3.6 Test result from storage tank (T2)

Item	T2 (Water treated by HMT-1200)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	19.7	18.8	18.4	18.6	18.6
Salinity (PSU)	31.2	31.3	31.4	31.1	31.2
TRO (mg/L)	0.09±0.02	0.03±0.01	0.01±0.01	0.01±0.01	0.01±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Table 3.3.7 Test result from storage tank (T3)

Item	T3 (Water treated by HMT-3000)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	19.6	18.1	18.5	18.7	18.6
Salinity (PSU)	31.2	31.5	31.4	31.3	31.4
TRO (mg/L)	0.10±0.02	0.04±0.01	0.00±0.01	0.00±0.01	0.00±0.01
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

Test Operator:

韩佳

Verifier:

刘增

Authorizer:

李先国

Monitoring (Inspection) Report

Ocean Monitoring and Inspection Center, Ocean University of China
(Attachment)

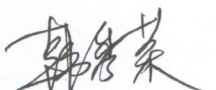
No. HDJC2012-005

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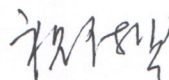
Table 3.3.8 Test result from storage tank (T4)

Item	T4 (Control Water)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	18.9	17.6	17.9	18.3	18.5
Salinity (PSU)	31.3	31.4	31.6	31.5	31.4
TRO (mg/L)	0.04±0.01	0.03±0.01	0.01±0.01	0.01±0.01	0.00±0.00
H ₂ (%LEL)	0.0	0.0	0.0	0.0	0.0

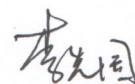
Test Operator:



Verifier:



Authorizer:



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No. HDJC2012-005

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4 Introduction of the project

A complete scaling test cycle includes ballasting and storage. Three types of OceanGuard™ Ballast Water Management Systems were tested in this project (with the capacity of 50 m³/h, 1200 m³/h, 3000 m³/h respectively).

An example of running of HMT-3000 system was given. Firstly, after starting the P3 pump, water goes through the filter (HMT-3000F), as well as the EUT unit (HMT-3000E) for treatment. Treated water goes into the sea after neutralization process of the neutralization unit (HMT-600N). During the treatment process, 1 m³ of treated water goes into the storage tanks, T3. Operation process of HMT-50 and HMT-1200 is the same as that of HMT-3000. The last step is simulating ballasting process of control water, i.e., water is pumped through the pump by the bypass pipe, and then goes into the sea directly. During the process, 1 m³ of control water goes into the storage tanks, T4. After ballasting, all the storage tanks will be covered with opaque cover to avoid sunlight. There are 3 sampling points in pipes of each system, for the sampling of influent water, treated water, and discharged water.

Water in storage tanks T1, T2, T3, T4 should be stored for 5 days. TRO concentration, temperature, salinity, and concentration of hydrogen gas in the top of the tank should be measured everyday during the 5 days' period.

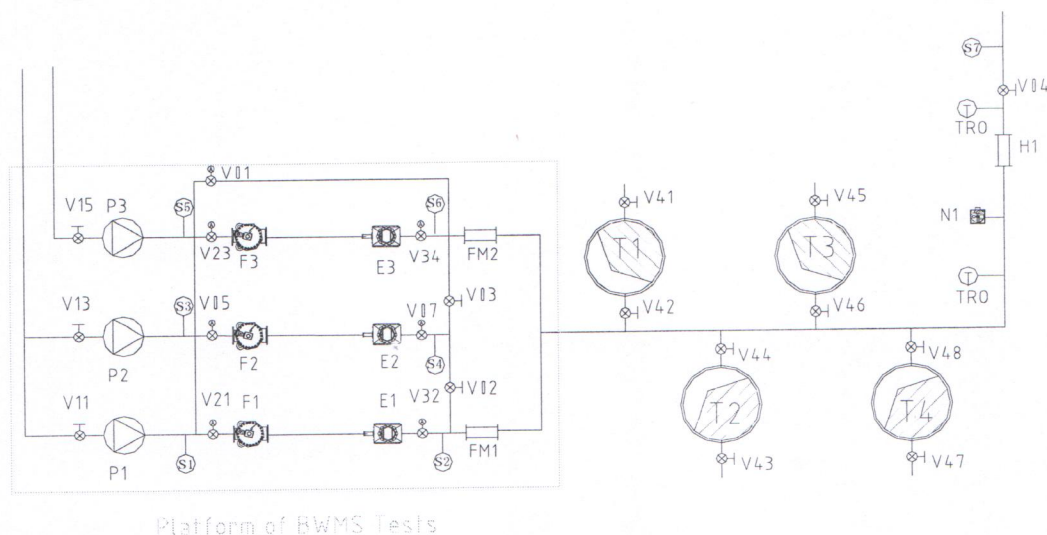


Figure 4.1 System layout of scaling test

Test Operator:

韩荣

Verifier:

初明

Authorizer:

李国

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Table 4.1 Notation for the system layout of scaling test

NO.	Name	Main Parameters	Model
P1	Ballast pump	Rated Capacity: 100 m ³ /h	——
P2	Ballast pump	Rated Capacity: 2200 m ³ /h	——
P3	Ballast pump	Rated Capacity: 2200 m ³ /h	——
F1	Filter	Rated Capacity: 50 m ³ /h	HMT-50F
F2	Filter	Rated Capacity: 1200 m ³ /h	HMT-1200F
F3	Filter	Rated Capacity: 3000 m ³ /h	HMT-3000F
E1	EUT Unit	Rated Capacity: 50 m ³ /h	HMT-50E
E2	EUT Unit	Rated Capacity: 1200 m ³ /h	HMT-1200E
E3	EUT Unit	Rated Capacity: 3000m ³ /h	HMT-3000E
FM1	Flow Meter	DN125	HMT-125FM
FM2	Flow Meter	DN600	HMT-600FM
N1	Neutralization Unit	Volume: 600L	HMT-600N
H1	Static Mixers	DN600	——
T1-T4	Tank	Volume: 1 m ³	——
V01-V48	Valve	——	——

Test Operator:

韩学荣

Verifier:

刘明

Authorizer:

李锐

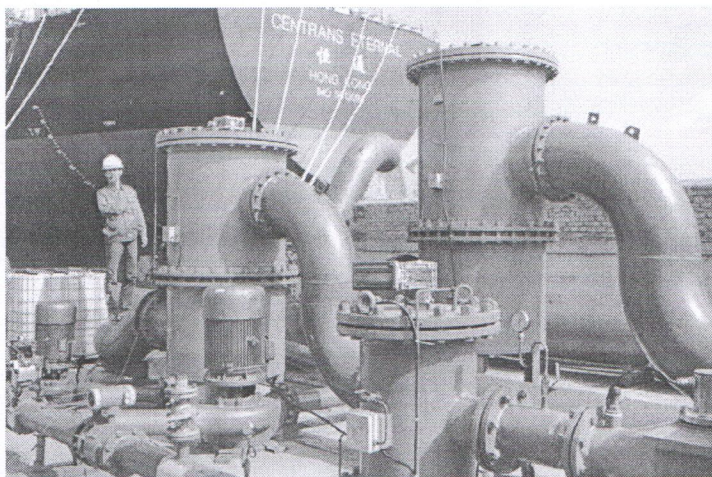
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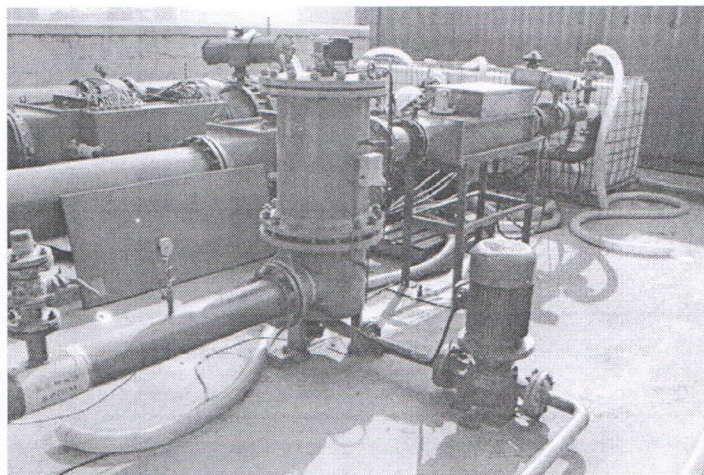
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5 Pictures of systems tested



Pic.5.1 Filter



Pic.5.2 EUT Unit

Test Operator:

韩秀荣

Verifier:

刘明华

Authorizer:

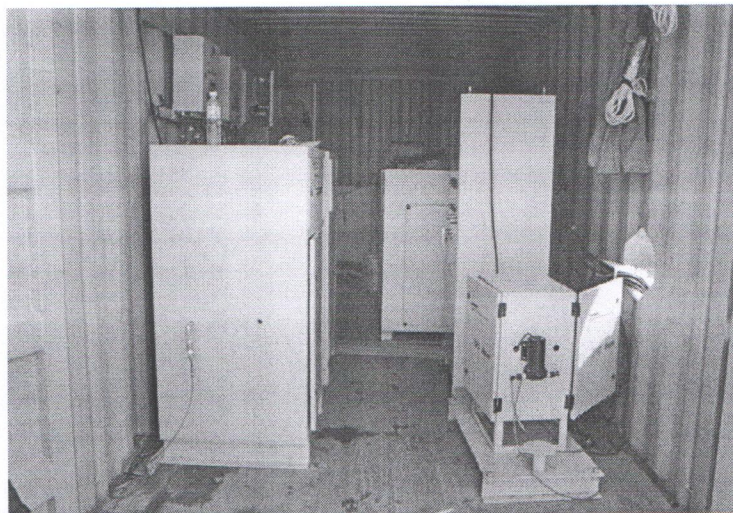
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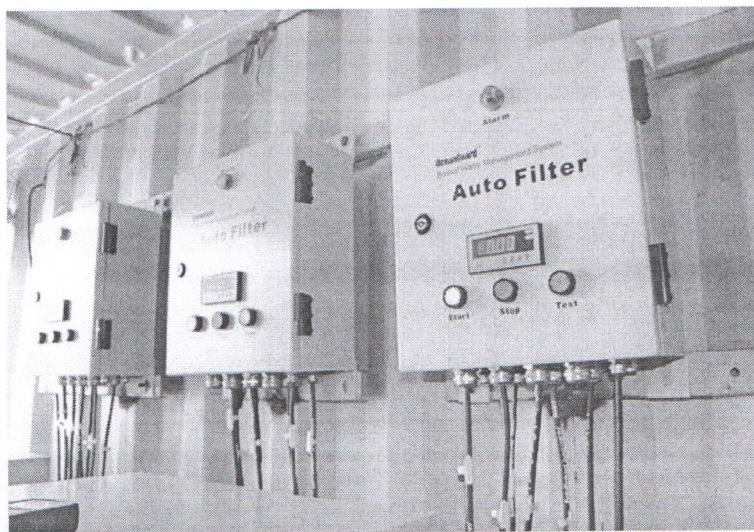
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Pic.5.3 Equipments layout of scaling test



Pic.5.4 Control box of Filter

Test Operator:

韩鲁荣

Verifier:

张明生

Authorizer:

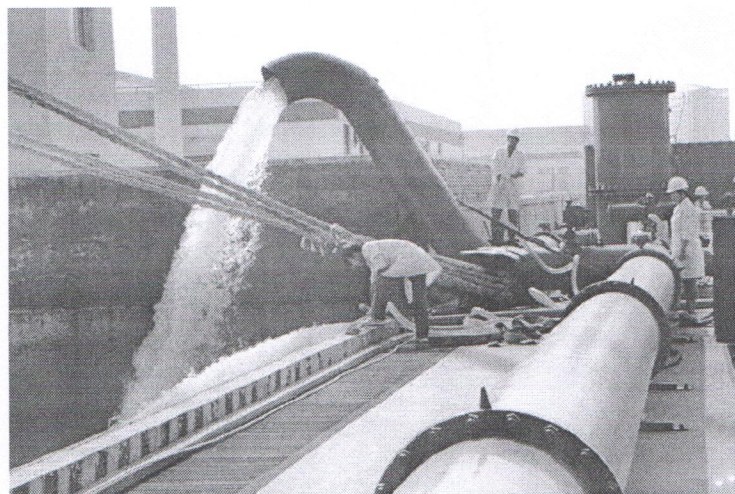
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Pic.5.5 Operation of the system

Test Operator:

韩学军

Verifier:

刘明

Authorizer:

李国

Checklist of Scaling Test of OceanGuard™ Ballast Water Management System

Checklist number: HMT-BWMS-ST-CN-01

Manufacturer: Qingdao Headway Technology Co., Ltd.

Place: 8 Wharf, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd.

Date: Sep., 25th, 2012, Tuesday

No.	To be checked	Yes/No	Mark
1	Installation of equipment		
1.1	OceanGuard™ BWMS of 50 m³/h		
1.1.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.1.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.1.3	Sampling point of influent water is before the Filter	Yes	
1.1.4	Sampling point of treated water is after the EUT Unit.	Yes	
1.1.5	Sampling point of discharging water is after the Neutralization Unit.	Yes	
1.1.6	A simulated ballast tank of 1m³ is near the system for storage of treated water.	Yes	
1.2	OceanGuard™ BWMS of 1200 m³/h		
1.2.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.2.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.2.3	Sampling point of influent water is before the Filter	Yes	
1.2.4	Sampling point of treated water is after the EUT Unit.	Yes	
1.2.5	Sampling point of discharging water is after the Neutralization Unit.	Yes	
1.2.6	A simulated ballast tank of 1m³ is near the system for storage of treated water.	Yes	
1.3	OceanGuard™ BWMS of 3000 m³/h		
1.3.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.3.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.3.3	Sampling point of influent water is before the Filter	Yes	
1.3.4	Sampling point of treated water is after the EUT Unit	Yes	
1.3.5	Sampling point of discharging water is after the Neutralization Unit	Yes	

☒ Witnessed ☐ Reviewed
 And found comply with
 Date: 2012-09-25
 By: [Signature]
 Del. Number: [Blank]
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1.3.6	A simulated ballast tank of 1m ³ is near the system for storage of treated water	Yes	
1.4	Bypass		
1.4.1	Open and close state of the bypass pipe is controlled by automatic valve	Yes	
1.4.2	There is a sampling point in the bypass	Yes	
1.4.3	A simulated ballast tank of 1m ³ is near the system for storage of treated water	Yes	
2	Operation of equipment		
2.1	OceanGuard™ BWMS of 50 m ³ /h		
2.1.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.1.2	There is normal display in the panel of control unit	Yes	
2.1.3	Flow rate is around 50 m ³ /h	Yes	73.69 m ³ /h
2.1.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.03 mg/L
2.1.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.1.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	
2.1.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.1.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.1.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	
2.2	OceanGuard™ BWMS of 1200 m ³ /h		
2.2.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.2.2	There is normal display in the panel of control unit	Yes	
2.2.3	Flow rate is around 1200 m ³ /h	Yes	1303 m ³ /h
2.2.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.00 mg/L
2.2.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.2.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0 mg/L
2.2.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.2.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.2.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	

☒ Witnessed ☐ Reviewed
 And found comply with
 Date: 2012-11-11
 Det Norske Veritas AS
 Qingdao

2.3	OceanGuard™ BWMS of 3000 m ³ /h		
2.3.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.3.2	There is normal display in the panel of control unit	Yes	
2.3.3	Flow rate is around 3000 m ³ /h	Yes	3079 m ³ /h
2.3.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.02 mg/L
2.3.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.3.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0 mg/L
2.3.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.3.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.3.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	
2.4	Operation of bypass		
2.4.1	Press the key of "Emergency On" in control unit, valve of the bypass is opened automatically, and other valves are closed	Yes	
2.4.2	Sound and light alarm is started	Yes	
2.4.3	Press the key of "Mute", and the sound alarm is silenced	Yes	
2.4.4	Press the key of "Emergency On" in control unit, valve of the bypass is closed automatically	Yes	
2.4.5	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	
3	Sampling, Storage and Transportation		
3.1	OceanGuard™ BWMS of 50 m ³ /h		
3.1.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.1.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.1.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.5	One parameter of treated water sampling is included: TRO	Yes	
3.1.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.7	One parameter of discharging water sampling is included: TRO	Yes	
3.1.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4°C immediately after sampling	Yes	



☒ Witnessed ☐ Reviewed

And found comply with

Date: 26/11/2012

Det. Name: Venter A.J.

On: 26/11/2012

3.1.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.1.10	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.2	OceanGuard™ BWMS of 1200 m ³ /h		
3.2.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.2.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.2.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.5	One parameter of treated water sampling is included: TRO	Yes	
3.2.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.7	One parameter of discharging water sampling is included: TRO	Yes	
3.2.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4°C immediately after sampling	Yes	
3.2.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.2.10	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.3	OceanGuard™ BWMS of 3000 m ³ /h		
3.3.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.3.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.3.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.5	One parameter of treated water sampling is included: TRO	Yes	
3.3.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.7	One parameter of discharging water sampling is included: TRO	Yes	
3.3.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4°C immediately after sampling	Yes	
3.3.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.3.10	Monitor concentration of hydrogen gas in simulated ballast	Yes	



	tanks	Yes	
3.4	Sampling of control water		
3.4.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.4.2	Sampling of control water: three parallel samples for each parameter at three different time respectively	Yes	
3.4.3	Three parameters of control water sampling are included: temperature and salinity, TSS, DOC and POC	Yes	
3.4.4	Samples that need to be tested in the lab, should be put into the thermal insulation box of $\leq 4^{\circ}\text{C}$ immediately after sampling.	Yes	
3.4.5	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.4.6	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.5	Sampling from simulated ballast tank (during storage)		
3.5.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.5.2	One sample for one parameter from each simulated ballast tank is taken	Yes	
3.5.3	One parameter of sampling is included: TRO	Yes	
3.5.4	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
4	On-site check		
4.1	All testing equipments have been calibrated with calibration label	Yes	
4.2	Three parameters are tested on-site: temperature, salinity, TRO	Yes	
4.3	Sensor thermometer is used to measure temperature	Yes	
4.4	Salinity meter of sensor type is used to measure temperature	Yes	
4.5	2800 spectrophotometer is used to monitor concentration of TRO	Yes	
4.6	Gas detector of sensor type is used to monitor concentration of hydrogen gas	Yes	
5	Check the data		
5.1	Concentration of hydrogen gas in all test cycles is below 4%	Yes	
5.2	TRO concentration of treated water is equal to 2 mg/L	Yes	
5.3	TRO concentration of discharging water is lower than 0.2 mg/L	Yes	



Checklist of Scaling Test of OceanGuard™ Ballast Water Management System

Checklist number: HMT-BWMS-ST-CN-02

Manufacturer: Qingdao Headway Technology Co., Ltd.

Place: 8 Wharf, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd.

Date: Oct., 10th, 2012, Wednesday

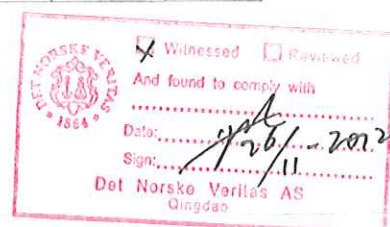
No.	To be checked	Yes/No	Mark
1	Installation of equipment		
1.1	OceanGuard™ BWMS of 50 m ³ /h		
1.1.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.1.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.1.3	Sampling point of influent water is before the Filter	Yes	
1.1.4	Sampling point of treated water is after the EUT Unit.	Yes	
1.1.5	Sampling point of discharging water is after the Neutralization Unit.	Yes	
1.1.6	A simulated ballast tank of 1m ³ is near the system for storage of treated water.	Yes	
1.2	OceanGuard™ BWMS of 1200 m ³ /h		
1.2.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.2.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.2.3	Sampling point of influent water is before the Filter	Yes	
1.2.4	Sampling point of treated water is after the EUT Unit.	Yes	
1.2.5	Sampling point of discharging water is after the Neutralization Unit.	Yes	
1.2.6	A simulated ballast tank of 1m ³ is near the system for storage of treated water.	Yes	
1.3	OceanGuard™ BWMS of 3000 m ³ /h		
1.3.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.3.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.3.3	Sampling point of influent water is before the Filter	Yes	
1.3.4	Sampling point of treated water is after the EUT Unit	Yes	
1.3.5	Sampling point of discharging water is after the Neutralization Unit	Yes	



1.3.6	A simulated ballast tank of 1m ³ is near the system for storage of treated water	Yes	
1.4	Bypass	Yes	
1.4.1	Open and close state of the bypass pipe is controlled by automatic valve	Yes	
1.4.2	There is a sampling point in the bypass	Yes	
1.4.3	A simulated ballast tank of 1m ³ is near the system for storage of treated water	Yes	
2	Operation of equipment		
2.1	OceanGuard™ BWMS of 50 m ³ /h		
2.1.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.1.2	There is normal display in the panel of control unit	Yes	
2.1.3	Flow rate is around 50 m ³ /h	Yes	13.85m ³ /h
2.1.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	204mg/L
2.1.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.1.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	
2.1.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.1.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.1.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	
2.2	OceanGuard™ BWMS of 1200 m ³ /h		
2.2.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.2.2	There is normal display in the panel of control unit	Yes	
2.2.3	Flow rate is around 1200 m ³ /h	Yes	1270m ³ /h
2.2.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	206mg/L
2.2.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.2.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0mg/L
2.2.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.2.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.2.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	

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 And found to comply with
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 Signature: [Signature]
 Dist. Watchdog Training Ltd

2.3	OceanGuard™ BWMS of 3000 m³/h		
2.3.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.3.2	There is normal display in the panel of control unit	Yes	
2.3.3	Flow rate is around 3000 m³/h	Yes	3145 m³/h
2.3.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.03 mg/L
2.3.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.3.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0 mg/L
2.3.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.3.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.3.9	During operation, 1 m³ of water goes into simulated ballast tank	Yes	
2.4	Operation of bypass		
2.4.1	Press the key of "Emergency On" in control unit, valve of the bypass is opened automatically, and other valves are closed	Yes	
2.4.2	Sound and light alarm is started	Yes	
2.4.3	Press the key of "Mute", and the sound alarm is silenced	Yes	
2.4.4	Press the key of "Emergency On" in control unit, valve of the bypass is closed automatically	Yes	
2.4.5	During operation, 1 m³ of water goes into simulated ballast tank	Yes	
3	Sampling, Storage and Transportation		
3.1	OceanGuard™ BWMS of 50 m³/h		
3.1.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.1.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.1.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.5	One parameter of treated water sampling is included: TRO	Yes	
3.1.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.7	One parameter of discharging water sampling is included: TRO	Yes	
3.1.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4℃ immediately after sampling	Yes	



3.1.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.1.10	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.2	OceanGuard™ BWMS of 1200 m ³ /h		
3.2.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.2.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.2.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.5	One parameter of treated water sampling is included: TRO	Yes	
3.2.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.7	One parameter of discharging water sampling is included: TRO	Yes	
3.2.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4°C immediately after sampling	Yes	
3.2.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.2.10	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.3	OceanGuard™ BWMS of 3000 m ³ /h		
3.3.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.3.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.3.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.5	One parameter of treated water sampling is included: TRO	Yes	
3.3.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.7	One parameter of discharging water sampling is included: TRO	Yes	
3.3.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4°C immediately after sampling	Yes	
3.3.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.3.10	Monitor concentration of hydrogen gas in simulated ballast	Yes	



	tanks	Yes	
3.4	Sampling of control water		
3.4.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.4.2	Sampling of control water: three parallel samples for each parameter at three different time respectively	Yes	
3.4.3	Three parameters of control water sampling are included: temperature and salinity, TSS, DOC and POC	Yes	
3.4.4	Samples that need to be tested in the lab, should be put into the thermal insulation box of $\leq 4^{\circ}\text{C}$ immediately after sampling.	Yes	
3.4.5	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.4.6	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.5	Sampling from simulated ballast tank (during storage)		
3.5.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.5.2	One sample for one parameter from each simulated ballast tank is taken	Yes	
3.5.3	One parameter of sampling is included: TRO	Yes	
3.5.4	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
4	On-site check		
4.1	All testing equipments have been calibrated with calibration label	Yes	
4.2	Three parameters are tested on-site: temperature, salinity, TRO	Yes	
4.3	Sensor thermometer is used to measure temperature	Yes	
4.4	Salinity meter of sensor type is used to measure temperature	Yes	
4.5	2800 spectrophotometer is used to monitor concentration of TRO	Yes	
4.6	Gas detector of sensor type is used to monitor concentration of hydrogen gas	Yes	
5	Check the data		
5.1	Concentration of hydrogen gas in all test cycles is below 4%	Yes	
5.2	TRO concentration of treated water is equal to 2 mg/L	Yes	
5.3	TRO concentration of discharging water is lower than 0.2 mg/L	Yes	



Checklist of Scaling Test of OceanGuard™ Ballast Water Management System

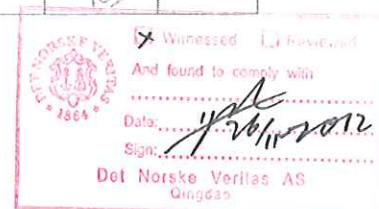
Checklist number: HMT-BWMS-ST-CN-03

Manufacturer: Qingdao Headway Technology Co., Ltd.

Place: 8 Wharf, Qingdao Beihai Shipbuilding Heavy Industry Co., Ltd.

Date: Oct., 16th, 2012, Tuesday

No.	To be checked	Yes/No	Mark
1	Installation of equipment		
1.1	OceanGuard™ BWMS of 50 m³/h		
1.1.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.1.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.1.3	Sampling point of influent water is before the Filter	Yes	
1.1.4	Sampling point of treated water is after the EUT Unit.	Yes	
1.1.5	Sampling point of discharging water is after the Neutralization Unit.	Yes	
1.1.6	A simulated ballast tank of 1m³ is near the system for storage of treated water.	Yes	
1.2	OceanGuard™ BWMS of 1200 m³/h		
1.2.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.2.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.2.3	Sampling point of influent water is before the Filter	Yes	
1.2.4	Sampling point of treated water is after the EUT Unit.	Yes	
1.2.5	Sampling point of discharging water is after the Neutralization Unit.	Yes	
1.2.6	A simulated ballast tank of 1m³ is near the system for storage of treated water.	Yes	
1.3	OceanGuard™ BWMS of 3000 m³/h		
1.3.1	Components of the System: Filter, EUT Unit, Control Unit, Power Distribution Unit, EUT Power Unit, Neutralization Unit, Monitoring Unit, Flow Meter	Yes	
1.3.2	System piping arrangement is consistent with QAPP (please refer to P4 in QAPP for details)	Yes	
1.3.3	Sampling point of influent water is before the Filter	Yes	
1.3.4	Sampling point of treated water is after the EUT Unit	Yes	
1.3.5	Sampling point of discharging water is after the Neutralization Unit	Yes	



1.3.6	A simulated ballast tank of 1m ³ is near the system for storage of treated water	Yes	
1.4	Bypass		
1.4.1	Open and close state of the bypass pipe is controlled by automatic valve	Yes	
1.4.2	There is a sampling point in the bypass		
1.4.3	A simulated ballast tank of 1m ³ is near the system for storage of treated water	Yes	
2	Operation of equipment		
2.1	OceanGuard™ BWMS of 50 m ³ /h		
2.1.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.1.2	There is normal display in the panel of control unit	Yes	
2.1.3	Flow rate is around 50 m ³ /h	Yes	59.20m ³ /h
2.1.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.04 mg/L
2.1.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.1.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0mg/L
2.1.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.1.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.1.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	
2.2	OceanGuard™ BWMS of 1200 m ³ /h		
2.2.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.2.2	There is normal display in the panel of control unit	Yes	
2.2.3	Flow rate is around 1200 m ³ /h	Yes	1285m ³ /h
2.2.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.03mg/L
2.2.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.2.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0mg/L
2.2.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.2.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.2.9	During operation, 1 m ³ of water goes into simulated ballast tank	Yes	



2.3	OceanGuard™ BWMS of 3000 m³/h		
2.3.1	Press the key "Ballast on", automatic valves are open or closed in normal state	Yes	
2.3.2	There is normal display in the panel of control unit	Yes	
2.3.3	Flow rate is around 3000 m³/h	Yes	2006 m³/h
2.3.4	There is display of TRO concentration after the EUT unit, and the value is equal to 2 mg/L	Yes	2.05 mg/L
2.3.5	When the Neutralization Unit starts work, neutralizer is added into the pipe	Yes	
2.3.6	TRO concentration after the neutralization unit is lower than 0.2 mg/L	Yes	0.0 mg/L
2.3.7	Press the key "Ballast off", the automatic valve works in normal state	Yes	
2.3.8	There is record in the Log of Control Unit, and the time recorded as well as contents are correct	Yes	
2.3.9	During operation, 1 m³ of water goes into simulated ballast tank	Yes	
2.4	Operation of bypass		
2.4.1	Press the key of "Emergency On" in control unit, valve of the bypass is opened automatically, and other valves are closed	Yes	
2.4.2	Sound and light alarm is started	Yes	
2.4.3	Press the key of "Mute", and the sound alarm is silenced	Yes	
2.4.4	Press the key of "Emergency On" in control unit, valve of the bypass is closed automatically	Yes	
2.4.5	During operation, 1 m³ of water goes into simulated ballast tank	Yes	
3	Sampling, Storage and Transportation		
3.1	OceanGuard™ BWMS of 50 m³/h		
3.1.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.1.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.1.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.5	One parameter of treated water sampling is included: TRO	Yes	
3.1.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.1.7	One parameter of discharging water sampling is included: TRO	Yes	
3.1.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4°C immediately after sampling	Yes	



3.1.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.1.10	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.2	OceanGuard™ BWMS of 1200 m ³ /h		
3.2.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.2.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.2.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.5	One parameter of treated water sampling is included: TRO	Yes	
3.2.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.2.7	One parameter of discharging water sampling is included: TRO	Yes	
3.2.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4 °C immediately after sampling	Yes	
3.2.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.2.10	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.3	OceanGuard™ BWMS of 3000 m ³ /h		
3.3.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.3.2	Sampling of influent water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.3	Three parameters of influent water sampling are included: temperature and salinity, TSS, DOC, POC, organisms ≥50µm, organisms ≥10-50µm and bacteria	Yes	
3.3.4	Sampling of treated water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.5	One parameter of treated water sampling is included: TRO	Yes	
3.3.6	Sampling of discharging water: three parallel samples for each parameter at three different time respectively	Yes	
3.3.7	One parameter of discharging water sampling is included: TRO	Yes	
3.3.8	Samples that need to be tested in the lab, should be put into the thermal insulation box of ≤4 °C immediately after sampling	Yes	
3.3.9	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.3.10	Monitor concentration of hydrogen gas in simulated ballast	Yes	

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 And found to comply with
 Date: 26/11/2012
 Sign: [Signature]
 Del Norske Veritas AS
 Qingdao

	tanks	Yes	
3.4	Sampling of control water		
3.4.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.4.2	Sampling of control water: three parallel samples for each parameter at three different time respectively	Yes	
3.4.3	Three parameters of control water sampling are included: temperature and salinity, TSS, DOC and POC	Yes	
3.4.4	Samples that need to be tested in the lab, should be put into the thermal insulation box of $\leq 4^{\circ}\text{C}$ immediately after sampling.	Yes	
3.4.5	Samples in the thermal insulation box should be delivered to the lab within 6 hours	Yes	
3.4.6	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
3.5	Sampling from simulated ballast tank (during storage)		
3.5.1	Sampling bottles are numbered regularly, labels are waterproof and stuck firmly	Yes	
3.5.2	One sample for one parameter from each simulated ballast tank is taken	Yes	
3.5.3	One parameter of sampling is included: TRO	Yes	
3.5.4	Monitor concentration of hydrogen gas in simulated ballast tanks	Yes	
4	On-site check		
4.1	All testing equipments have been calibrated with calibration label	Yes	
4.2	Three parameters are tested on-site: temperature, salinity, TRO	Yes	
4.3	Sensor thermometer is used to measure temperature	Yes	
4.4	Salinity meter of sensor type is used to measure temperature	Yes	
4.5	2800 spectrophotometer is used to monitor concentration of TRO	Yes	
4.6	Gas detector of sensor type is used to monitor concentration of hydrogen gas	Yes	
5	Check the data		
5.1	Concentration of hydrogen gas in all test cycles is below 4%	Yes	
5.2	TRO concentration of treated water is equal to 2 mg/L	Yes	
5.3	TRO concentration of discharging water is lower than 0.2 mg/L	Yes	

